

16 2 (2004 6)
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TDI

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2)
3)
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2)
3)
2)
2)

Abstract

The Prevalence of Occupational Asthma in TDI-Exposed Workers

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Objectives: This study was carried out to estimate the prevalence of isocyanate-induced occupational asthma in toluene diisocyanate (TDI) exposed workers.

Methods: We examined 170 workers who had been directly exposed to TDI through a medical questionnaire, physical examination, and pulmonary function test. Based on screening examination, workers with suspected occupational asthma were selected for further evaluation such as methacholine and TDI challenge tests.

Results: Eleven (6.9%) among 170 workers complained of symptoms of occupational asthma, and 7 among these 11 symptomatic workers showed positive responses to the methacholine challenge test (4.1%). One spray painter was confirmed as having the TDI induced occupational asthma following a positive response to TDI challenge test.

Conclusions: The prevalence of TDI-induced asthma was at 0.58% was lower than that for former studies (2-20%). Improved workplace environment, lower level of TDI exposure compared to the past, and the healthy workers effect may have contributed to this low rate of asthma prevalence in workers with TDI exposure.

Key Words: Occupational asthma, TDI, Prevalence

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가 ,
가
, (McDonald , 2000)
가 가
5%가 ,
3%
(Friedman , 2000).
2
4% 가
(, 1999).
(Bernstein,
1982). (1991)
가 ,
,
가 50%
,
, 5 121 TLV-STEL 가 (
(, 2003) ,
16 16 (, 2003),
, , 2 33 (TDI TDI
, 2004), 1970 5 ~ 6%
53 가
0 ~ 0.7%
(Ott , 2003). TDI
, TDI(Toluene diisocyanate)
가 가
(Malo Chan-Yeung, 2001).
, , , 13% (Park ,
1992), (1994) TDI
, TDI
, 1999 2.14%
(1995) TDI 21.6%
11 TDI가 7 ,
1 , 1 , 1 , 가 1
(, 2001).
, (. 1999). ,
1992-1999 44 TDI
가 25 , 가 10 , 9 TDI가
56.8% (,
2000). 5 (1998 ~ 2002) 10 TDI
, TDI가
43.8% ,
18.8%, , ,
36.5% .
, TDI

TDI

ISSAC

11 (Lee SI, 2001)

3 (, 1994)

1.

2

가

TDI 400 , 가

50 가 12 가 ?

TDI 가 ? 12

170 가

11 . 30 가 ?

, 5 12 가

, 135

가 ? 12 가

(Table 1).

가 12 가

2.

, 1 ?

(2003 5 ~ 10)

가 ? 12

, ? 12

가 2 가 ? 12

, 2 , 가 가

, ? 12

TDI 가 가

? . , , , 2

1)

가

1:1 가

가

Table 1. Types of industries of the subjects

Industries	Classification	Frequency (percent)
Polyurethane product		30 (17.6)
Polyurethane paint	Furniture	17 (10.0)
	Musical instruments	118 (69.4)
Polyurethane foam		5 (2.9)

. TDI
가 ? 24
a) b) . Devilbiss 646 nebulizer
c) d) 10
가 가 FEV1 . TDI
가 ? a) 가 b) 2,4-TDI
c) 가 (C₉H₆N₂O₂, Sigma, MO, USA) 20
가 ? a) 가 b) . 가 TLD-1 (MDA
c) Scientific, USA) TDI 20
ppb . 1
2) 10 3 , 30 1
2 , 7
FEV1 20%
. Methacholine chloride 0.075 mg/mL
25 mg/mL 9
5 (FVC)
3 1
(FEV1) 20% 1.
(PC20) .
40 가 가
3) TDI 52.4% , 20 가 13.5% 가
2 TDI . 122 71.8%

Table 2. General characteristics of the subjects

Characteristics	Classification	Frequency (percent)
Age (years)	20-29	23 (13.5)
	30-39	32 (18.8)
	40-49	89 (52.4)
	50	26 (15.3)
Gender	male	122 (71.8)
	female	48 (28.2)
Exposure duration (years)	< 1	18 (10.6)
	1-4	42 (24.7)
	5-9	29 (17.1)
	10	81 (47.6)
Smoking	yes	78 (45.9)
	no	77 (45.3)
Alcohol	experienced	15 (8.9)
	1time week	95 (55.9)
	2-3times month	10 (5.9)
	not drinking	65 (38.2)

TDI

28.2% TDI 가 1

1 18 (10.6%), 1~4 42 3 TDI

(24.7%), 5~9 29 (17.1%), 10 81 ,

47.6% 가 TDI TDI

45.9% , 1 가 가 TDI

55.9% (Table 2). 10 1 TDI 20

TDI

2. (Fig. 1).

TDI

TDI

TDI

TDI 170 11 (6.5%)

2 (Table 4 No. 3 4) TDI

6 , 1

5 , TDI TDI

0.3 17 (Table 3). TDI 1

0.58%

3. TDI

TDI

11 170 TDI 1

7 가

(Table 4). TDI 6.9%가

11 TDI 10

TDI 10 ,

7 ,

Table 3. Selected subjects through the questionnaire and examination

No	Name	Industries	Sex	Age (yr)	Smoking	Work duration in factory (yr)	TDI Exposure - Sx [†] . onset (yr)
1	Kim IS	Polyurethane paint	F	54	-	15	1
2	Kwon HS	Polyurethane paint	M	47	+(20 PY*)	16	5
3	Yang SS	Polyurethane paint	F	49	-	0.4	0.3
4	Bang JI	Polyurethane paint	M	50	+(25 PY)	25	2
5	Bae DR	Polyurethane paint	F	40	0	7	5
6	Kim YH	Polyurethane paint	M	48	+(10 PY)	2	1
7	You BI	Polyurethane product	F	49	-	11	11
8	Yem KH	Polyurethane paint	M	43	+(25 PY)	15	13
9	Kim GN	Polyurethane product	M	41	+(10 PY)	18	17
10	Choi KJ	Polyurethane paint	F	49	-	6	5
11	Kang SM	Polyurethane paint	M	40	+(20 PY)	10	8

*, pack-year, [†];symptom

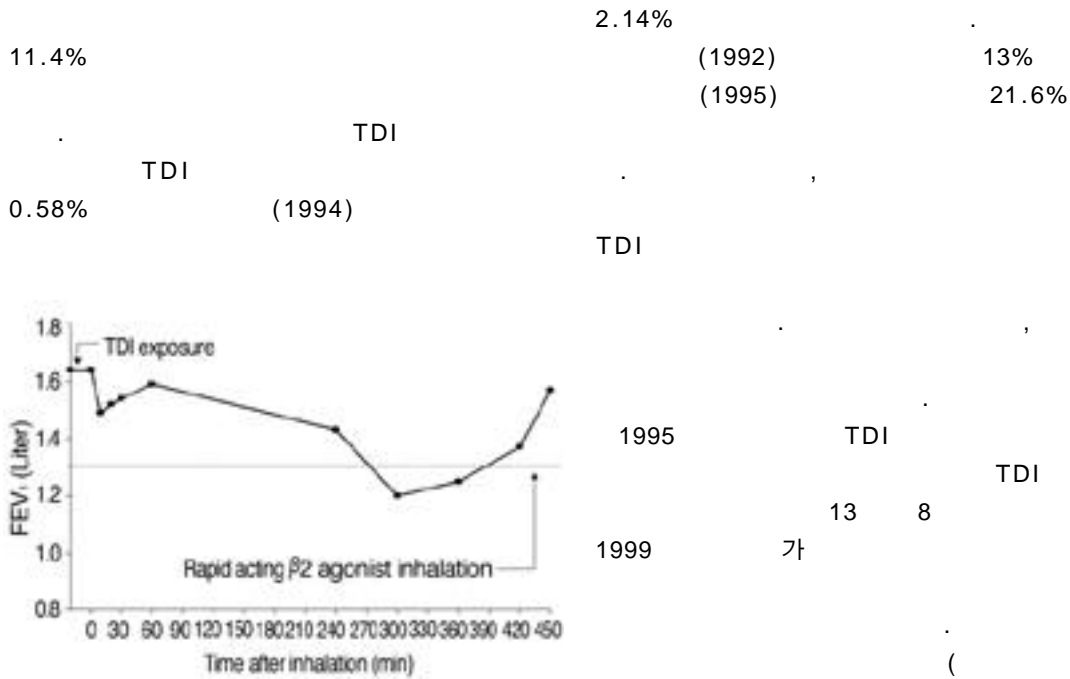


Fig. 1. Bronchial challenge test by exposure to TDI for 20 minute in one selected worker with suspected occupational asthma (54 year-old female worker with height of 147 cm and weight of 45 Kg).

Table 4. The result of work-relatedness evaluations

No	Name	FEV ₁ (%)	FVC (%)	Methacholine challenge	PC20 (mg/ml)	TDI challenge	Skin test
1	Kim IS	102.8	103.8	+	7.51	Late +	All (-)
2	Kwon HS	110.1	112.1	+	0.54	-	All (-)
3	Yang SS	81.5	97.3	+	9.01	- (2 times)	All (-)
4	Bang JI	100.9	106.2	+	8.16	- (2 times)	HDM 2+
5	Bae DR	95.5	97.8	+	1.86	-	Mugwort 2+
6	Kim YH	98.1	107.4	+	7.66	-	All (-)
7	You BI	97.3	101.1	+	21.6	-	Cockroach 3+
8	Yem KH	108.8	110.6	-	> 25	-	All (-)
9	Kim GN	110.2	104.6	-	> 25	-	All (-)
10	Choi KJ	106.5	106.6	-	> 25	-	HDM 2+
11	Kang SM	98.9	104.6	-	> 25	NT	All (-)

FVC: forced vital capacity, % of predicted value

FEV₁: forced expiratory volume for 1 second, % of predicted value

PC20: provocative concentration of methacholine responsible for 20% decrement of FEV₁

NT: not-tested

HDM: house dust mite

TDI



Fig. 2. The trend of changes in TDI exposure level (20factories)

가 . TDI
5~6% 가 ,
2-20%
가 가 , TDI
50~100%, 가
100~70%가 (, ,
1997).
ISSAC (Asher , 1995) TDI 400 ,
(Lee SI , 2001). 가 50 가 TDI
가 , 가, 170
TDI , TDI
1 : 11 (6.9%), 7
가 . TDI
1
가 , TDI
0.58% .
: TDI
2~20% ,
0.58% .
가
가 .
TDI , TDI 가 가
가 .
8 (1992-
1999)
2000;12(2):292-301.
Diisocyanate
, 1995.
2003;15(1):95-
110.
: TDI

- 1994;47(4):439-53.
- 2003;16(1):1-12.
- 2003;15(4):344-50.
- 1993;13(3):265-78.
- 1997; 17(4): 487-95.
- : 1999
- 2001;13(4):449-60.
- 1999;11(2):174-80.
- (II).
- . 1999.
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